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Atlantic City International Airport,
NJ 08405

User Preferred Fire Suppression Agent for Lavatory Trash Container Fire Protection

April 1996

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Final Report of Lavatory Trash Receptacle Fire
Suppression Agent Preference Task Group of the
International Halon Replacement Working Group

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TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	v
BACKGROUND	1
SURVEY RESULTS	1
RECOMMENDATIONS	1
APPENDICES	
A -- Supplementary Information/Survey	
B -- List of Task Group Members	

LIST OF TABLES

Table	Page
1 Responses to Survey: User Preferred Agent for Lavatory Trash Container Fire Protection	2

EXECUTIVE SUMMARY

The results of the survey sent to airlines and airframe manufacturers on Lavatory Trash Receptacle Fire Suppression Agent Preference are compiled in this report. Tests are recommended to define the quantity of water required for fire extinguishment.

BACKGROUND

At the meeting of the International Halon Working Group held in Rome, April 1995, a suggestion was made and accepted to query the airlines as to an acceptable/preferred firefighting agent for use in the lavatory trash receptacle. As a direct result of this suggestion, a Task Group was formed that prepared a package, including background information and a questionnaire, for querying the airlines on their preference for a replacement agent for Halon 1301 in lavatory trash receptacle extinguishers. The survey package is shown in appendix A. A list of the task group members is shown in appendix B. The complete package was sent out by the FAA Technical Center to airlines, airframe manufacturers, and aviation authorities throughout the world. At the follow-on meeting held in Albuquerque, New Mexico, July 1995, Task Group members agreed to review the returned surveys and reach a consensus on how to report the results.

SURVEY RESULTS

A summary of the responses from those airlines who completed the questionnaire is shown in table 1.

Sixteen respondents (66%) listed halocarbon and/or a halocarbon blend as the preferred agent with reasons given as weight, minimum impact on current installation, and effectiveness in suppressing/extinguishing the fire threat. The downside mentioned was halocarbon's global warming potential (GWP).

Four respondents (16%) preferred water. The reasons given were it is environmentally friendly and less maintenance is required. The negatives given were the weight and questions as to its effectiveness.

Three additional comments were received questioning the selection of 33°F as the minimum operational temperature in the standard. Each of these comments suggested that the temperature should be lower, with one suggestion of 0°F as a more appropriate value.

RECOMMENDATIONS

Perform the test procedure defined in the Minimum Performance Criteria for Replacement of Lavatory Disposal Receptacle Built-in Fire Extinguisher to determine the amount of water required to satisfy the minimum performance standard. This would allow for a more fully defined water-based system to be evaluated.

TABLE 1. RESPONSES TO SURVEY: USER PREFERRED AGENT FOR LAVATORY TRASH
CONTAINER FIRE PROTECTION

Company	Name	Preference				Comments
		1	2	3	4	
Aer Lingus		Halocarbon	Halocarbon Blends	Water Based	Water	Halocarbon has the optimum combination of efficiency, system compatibility, and cost Min Op. Temp of 33°F is not acceptable (0°F maybe?) Min Op. Temp of 33°F is too high
Aerospatiale		Halocarbon	Halocarbon Blends	Water Based	Water	
Airbus Industrie		Halocarbon	Halocarbon Blends	Water Based	Water	
Alitalia		Halocarbon	Halocarbon Blends	Water	Water Based	Avoid major modifications to existing a/c
Aloha Airlines		Halocarbon and Blends	Water/Water Based			
American Airlines		Halocarbon and Blends	Water and Water Based			
American Trans Air		Water & Water Based	Halocarbon & Blends			In addition to weight, system retrofit and cost must be considered.
British Airways		HFC-227	HFC-125	FC-3-1-10	FC-218	None are "Desired" these are the least undesirable. Triiodide should not be excluded.
British Airways		Halocarbon and Blends	Water	Powder Aerosols	Water/Foam	
Canadian Airlines International		Halocarbon and Blends	Water and Water Based			FM-200 looks promising. Concerns with water and non-paper (plastic) refuse.
Delta Air Lines		Halocarbon and Blends	Water and Water Based			Water disadvantages: wt penalty and effectiveness as fire suppression
EgyptAir						Approval from FAA/JAA, low cost.
Fokker (1)		Halocarbon and Blends	Water			If FM-200 is certifiable no additional evaluation is necessary.

TABLE 1. RESPONSES TO SURVEY: USER PREFERRED AGENT FOR LAVATORY TRASH
CONTAINER FIRE PROTECTION (Continued)

Company	Name	Preference			Comments
Hawaiian Airlines		Halocarbon and Blends	Water and Water Based		
Japan Airlines					Safe to humans and nature, easy clean up, availability, consistent w/other a/c agents.
Lufthansa		Halocarbon (HFC-227 ea)	Water		Water would be favorite if a simple reliable system were developed.
Philippine Airlines		Water and Water Based	Halocarbon and Blends		Water poses less maintenance is environmentally friendly.
Qantas Airways					Any replacement should be drop-in, gaseous preferred.
SAS		Water and Water Based			Fluorocarbons have high GWP, not accepted by environmentalists in Scandinavia.
SIA Engineering Co.		Water and Water Based			
Southwest Airlines		Halocarbon and Blends	Water and Water Based		Due to problems inherent to both, keep looking.
Swissair ⁽¹⁾		Halocarbon and Blends	Self Extinguishing Container		Low operating temp concern. Halocarbons seems to be perfect solution, Investigate container technology.
Transworld Airlines		Halocarbon and Blends	Water and Water Based		Halocarbon - superior fire suppression, less maintenance and volume.
United Airlines					Are powder/foam agents being tested?

⁽¹⁾Received when Notice was in the Draft format.
Sent out by FAA TC to over 50 interested parties.

APPENDIX A

SUPPLEMENTARY INFORMATION/SURVEY

APPENDIX A

USER PREFERRED FIRE SUPPRESSION AGENT FOR LAVATORY TRASH CONTAINER FIRE PROTECTION

ORGANIZATION: International Halon Replacement Working Group
Task Group-. User Preferred Agents for Lavatory Trash Containers

SUMMARY: This notice requests information from the user community on agent(s) that would or would not be considered for use in lavatory trash containers fire suppression systems. This information is requested to help guide the FAA in development of airworthiness criteria for the evaluation of non-halon fire suppression agents/systems.

DATES: Comments must be received by 30 June 1995.

ADDRESSES: Comments on this notice should be sent to:

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Task Group User Preferred Agents
Boeing Commercial Airplane Group
P.O. Box 3707 NVS 6H-PW
Seattle, WA 98124-2207 (USA)
Phone: 206-234-1366
Fax: 206-237-4831

FOR FURTHER INFORMATION CONTACT:

Bernd Dunker	DASA
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Felix Stossel	Swissair
Jelle Benedictus	YILM
Jean Paillet	Airbus
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Krijn Pellen	Fokker
Bud Roduta	United Airlines
John O'Sullivan	British Airways
John Blackburn	AVRO
Greg Grimstad	Boeing

SUPPLEMENTARY INFORMATION: At the fifth meeting of the International Halon Replacement Working Group (IHRWG), held 19-20 April 1995, in Rome, Italy, a Task Group was formed to determine the aviation industry's preferred fire suppression agent for use in lavatory trash containers. This information will serve to reduce the list of potential candidate agents and thus assist the regulatory authorities in planning their research activities to serve the aviation industry in an effective and timely manner.

Membership to this Task Group was limited to representatives from airframe manufacturers and airline operators. Persons identified above (Paragraph "For Further Information Contact") volunteered to serve in the Task Group. The Task Group was asked to:

- (1) Contact users (airframe manufacturers and airline operators) and determine agents they would or would not use for fire suppression in lavatory trash containers.
- (2) Prepare a report for presentation at the next IHRWG meeting, scheduled for IS July 1995.

You are encouraged to submit the questionnaire provided and any additional data, views, or arguments on agent(s) that you would (or would not) use for fire suppression in lavatory trash containers. If you have no preference, this information is also of value and we request that you communicate this position. The Task Group will be obligated to assume that if no comments are received by the due date of 14 July 1995, then no agent is preferred over another.

Availability of Notice

Any person may obtain a copy of this notice by requesting it from any member of the Task Group. Refer to paragraph "For Further Information Contact". By agreement of the [IHRWG only written comments from airframe manufacturers and airline operators will be considered.

Background

Given the phase out of halon production, (Montreal Protocol and US Clean Air Act) the Aerospace Industries Association (AIA) held an International Symposium - Halon Replacement in Aviation 9-10 February 1993. The symposium was attended by representatives from the Federal Aviation Administration (FAA). At this meeting it was concluded that:

- (1) current regulations do not require the use of halon,
- (2) no regulatory action is necessary, and
- (3) fire hazards, test protocols, and performance criteria all need to be developed.

On 17 June 1993, the FAA published Notice 93-1 in the Federal Register inviting industry to join in a cooperative effort to develop test articles, conduct evaluation tests, develop minimum performance standards, and provide guidance in drafting certification/compliance documents. This invitation resulted in the formation of the International Halon Replacement Working Group (MWG). Membership in the Group is open to all interested parties. The first meeting of the IHRWG was held on 13 October 1993, and the most recent, the fifth, was held 19-20 April 1995.

Halon production in the U.S. ceased as of 1 January 1994, due to its identification as an ozone destroying compound.

Discussion of trash container fire suppression

Fire protection requirements and characteristics of potential replacement agents are discussed in the next several sections.

Regulations

Federal Aviation Regulation FAR DOT 14CFR 121.308(b) requires that, "After April 29, 1987, no person may operate a passenger carrying transport category airplane unless each lavatory in the airplane is equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste located within the lavatory. The fire extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in the receptacle."

Present practice

Currently all aircraft lavatory disposal receptacle fire extinguishers use Halon 1301 as the fire suppression agent. The agent is contained in a pressurized bottle to which is connected a delivery tube and a nozzle. The bottle automatically discharges at a sense temperature in the range of 170°F- 175°F. This system is commonly referred to as a potty bottle.

International Halon Replacement Working Group (IHRWG)

The goal of the International Halon Replacement Working Group, is to introduce non-halon fire suppression systems into service in a timely, cost effective manner, with no compromise in safety. The Group is working all areas of fire protection onboard aircraft: engines and auxiliary power unit, cargo compartments, hand-held fire extinguishers for the occupied area, lavatory trash container, and dry bay (military). The IHRWG has formed several Task Groups to conduct specialized studies. Studies applicable to trash container fire suppression are:

- (1) Chemical Options to Halons for Aircraft Use, Published by the FAA as DOT/FAA/CT-95/9. (Task Group 6).
- (2) Proposed Methodology for Lavatory Disposal Receptacle Built-in Fire Extinguisher Agent Evaluation (Task Group 7).

The above two reports are in public domain and are available from the FAA Technical Center, New Jersey. [Contact Ms. April Homer, Phone 609-495-4471, Fax 609-646-5229].

At the April meeting it was suggested that the end users be queried as to any preference for the agents recommended by Task Group 6. These agents are:

- (1) water and water based agents, and
- (2) halocarbon and halocarbon blends.

There are several agents in each of these two classes and each agent/class has its pros and cons. Several members of the IHRWG commented at the Rome meeting that they would or would not

use certain agents. These remarks caused the IHRWG to form this Task Group. The Group has been tasked to determine why some fire extinguishing agent/system would or would not be considered for use by the aviation industry. The FAA believes this activity will reduce the number of potential candidates to be evaluated. Any reduction in the number of candidates at this early stage will assist the industry in arriving at an acceptable replacement agent or agents in a timely manner.

Trash container fire suppression system minimum performance standard

FAA/JAA have established that non-halon fire suppression system should provide the same level of protection (safety) as the present halon systems. In particular, the system must be capable of suppressing the test fire developed by Task Group 7, and defined in the report "Proposed Methodology for Lavatory Disposal Receptacle Built-in Fire Extinguisher Agent Evaluation."

Lavatories are located in the pressurized shell and the environmental conditions are similar to the conditions in the occupied areas. The likely ignition source is burning material discarded into the trash container-I the probability of this occurring is greatest when passengers are on board. The minimum operational temperature has been identified as 33°F by Task Group 7.

Water and water based agent bottle

Water and water based agents are recognized as effective fire suppression agents for Class A (paper) fires. Water is universally available at very reasonable cost and has no environmental restrictions or toxicity implications. The fire suppression agent could be ordinary water, distilled water, ionized water and may (or may not) contain additives. Additives, if used, could be for depressing the agent freezing point and/or modifying surface tension to enhance the fire suppression effectiveness. Several manufacturers claim biodegradable, environmentally safe additives which enhance fire suppression effectiveness.

A pressurized bottle using water as an agent was tested in some early agent evaluation trials. The water was able to knock-down the flames but re-ignition was found to be a problem. These tests while informative were by no means exhaustive in determining the optimum parameters of water volume, pressure, or nozzle design. An estimate of 1 liter of water does not seem unreasonable, which, if the system was to use a dedicated water supply, would adversely impact system weight. The weight impact could be avoided if wash basin water were to be used.

Halocarbon and halocarbon blend bottle

A halocarbon or halocarbon blend bottle would be similar to the present Halon 1301 bottle. Depending on agent boiling point, pressurization by an inert gas may be required. Commercialized zero Ozone Depletion Potential (ODP) fire suppressing agents and their characteristics are listed in Table A-1. Presently, there are no generally accepted standards, or restrictions, based on Global Warming Potential (GWP) and/or Atmospheric Life Time,

however, the lower these values the better. All agents listed are acceptable to the U.S. Environmental Protection Agency.

The design concentrations shown in Table A-1 are for extinguishment of Class B fires using n-heptane as fuel, rather than the Class A (paper) fire that would be expected in a trash container. Therefore, the design concentrations listed are not directly applicable to the expected threat and are provided for information purposes only. Tests have not been performed, for the potential threat, using all the listed halocarbons and relevant data is not available.

[Walter Kidde Aerospace has performed some preliminary tests using FM-200 and have reported fire suppression performance equivalent to that of Halon 1301 with approximately 0.291 pounds (132 grams) of the agent. These tests were done by using the same size bottle as the current Halon 1301 configuration.]

Halocarbons are non-toxic, see LOAFEL and NOAEL values in Table A-1. The halocarbon bottle maintenance requirements can be reasonably assumed to be the same as the present Halon 1301 system.

Table A-1: Significant Characteristics of Commercialized Total Flood Halocarbon Agents.
(data extracted from DOT/FAA/CT-95/9 and NFPA Standard 2001)

Agent	Chemical Name	Trade Name	GWPa	Atmospheric Life time, yrs	SNAP ^b approval	NFPA ^c recognized
HFC-23	Trifluoromethane	DuPont "FE-13"	9000	280	acceptable	yes
HFC-125	Pentafluoroethane	DuPont "FE-25"	3400	41	acceptable	yes
HFC-227ea	Heptafluoropropane	Great Lakes "FM-200"	2050	31	acceptable	yes
HFC-236fa	Hexafluoropropane	DuPont "FE-36"				
FC-218	Perfluoropropane	3M "CEA-308"	6100	3200	acceptable	
FC-3-1-10	Perfluorobutane	3M "CEA 410"	5500	2600	acceptable	yes

^a Based on 100-year horizon, relative to CO₂

^b Significant New Alternatives Policy

^c National Fire Protection Association Standard 2001, "Alternative Protection Options to Halon"

Agent	NOAEL ^d %	LOAEL ^e %	% Design ^f Concentr.(%)	Weight ^g Equiv.	Volume ^g Equiv.	Fill Density (lb/ft ³)	Storage Press (psig)	Freezing ^h Temp (°F)
HFC-23	30	>50	16.0	1.68 (1.7)	2.10 (2.2)	54.0	608.9	-247.4
HFC-125	7.5	10.0	10.9	1.88 (1.9)	2.44 (2.3)	58.0	166.4	-153.0
HFC-227ea	9.0	10.5	7.0	1.66 (1.7)	1.61 (1.6)	72.0	166.4	-204.0
HFC-236fa	10.0	15.0	6.4					
FC-218	30	40	8.8			80.0	360.0	
FC-3-1-10	40	>40	6.0	1.91 (1.9)	1.67 (1.7)	80	360	-198.8

^d No Observed Adverse Effect Level

^e Lowest Observed Adverse Effect Level

^f Manufacturer (HFC-236fa, FC-218) and Federal Register (HFC-23, HFC-125, HFC-227ea, FC-3-1-10) data

^g Calculated from data in NFPA Standard 2001. Values in parentheses taken from SNAP listing.

^h At 14.7 psia 760 mm Hg) pressure.

International Halon Replacement Working Group
User Preferred Agent for Lavatory Trash Container - Questionnaire

Name: _____ **Fax:** _____

Company: _____ **Tel:** _____

A) Two agent categories (water/water based and halocarbon/halocarbon blends) have been identified for lavatory trash container fire suppression.

Please list in order of preference and/or identify an alternative.

1. most desired, 4. least desired

Additional comments are encouraged, attach pages as required.

If you have no preference, skip to B).

1. _____

2. _____

3. _____

4. _____

B) Comments or suggestions, (attach additional pages as required).

C) Please return, by mail or fax, on or before 12 July 1995

Mail: Boeing Commercial Airplane Group

P.O. Box 3707 M/S 6H-PW

Seattle, WA USA 98124-2207

Attention: Greg Grimstad

Fax: 206 237 4831

APPENDIX B

LIST OF TASK GROUP MEMBERS

APPENDIX B

LIST OF TASK GROUP MEMBERS

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